FLOOD EVENT REPORT - NOVEMBER 2004

Lower Colorado River Authority

Introduction

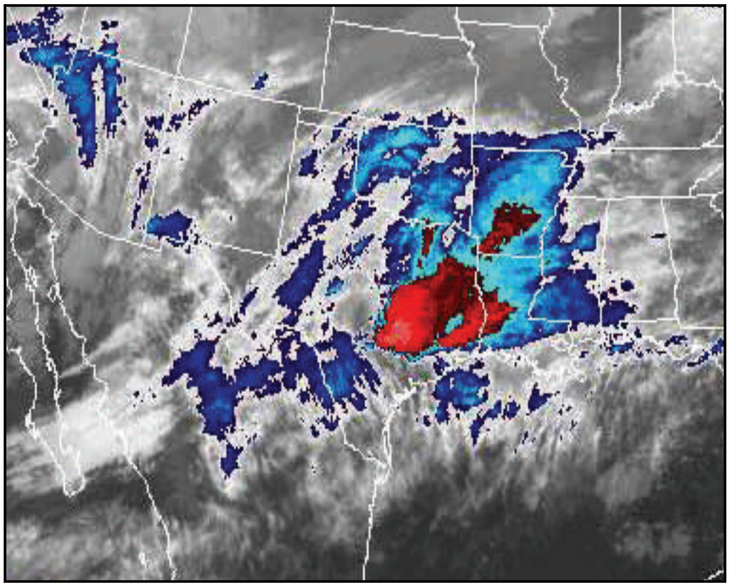

Figure 1 — NOAA Satellite Image, Nov. 22, 2004

A series of storms moved across Texas during November 2004, resulting in one of the wettest Novembers in Texas since statewide weather records began in 1895. Rainfall totals between 10 and 15 inches across Central Texas and 17 to 18 inches in the coastal counties made this the wettest November on record for Austin-Camp Mabry and Victoria (See Table 1). Across the Colorado River basin, there were three distinct periods of very heavy rain, severe storms and flooding that impacted different portions of the Colorado River basin. The changing patterns of heavy rainfall and flood runoff required LCRA to constantly evaluate conditions and adjust flood control operations on the Highland Lakes. On Nov. 24, Lake Travis reached a peak elevation of 696.7 feet above mean sea level (msl), its highest level since June 1997 and the fifth highest level on record. The Colorado River at Wharton reached a stage of 48.26 feet, its highest level since October 1998 and the ninth highest level on record. Flood control operations continued on the Highland Lakes for three months, from Nov. 17, 2004 until Feb. 17, 2005.

Weather Summary

November's unusually wet weather was the result of a series of low pressure troughs moving across Texas from the southwestern United States. A very moist flow from the eastern Pacific Ocean, generated by a weak El Niño in combination with a very moist flow off the Gulf of Mexico, produced three distinct periods of very heavy rain, severe storms and flooding that successively affected the Highland Lakes basin, the coastal plains, and finally the lower Colorado River basin from Austin to Columbus.

Nov. 14 - 19: Highland Lakes Basin

November's pattern of wet weather began Nov. 14 when a strong storm system approached Texas from northern Mexico. Waves of low pressure moving across Central Texas over the next few days produced periods of moderate to heavy rain. Light to moderate rains, with totals of 0.25 to 0.50 inch, fell across the Hill Country and much of Central Texas on Nov. 14 and 15. Rainfall increased in intensity from late on Nov. 15 through Nov. 16 with widespread totals of 1 to 3 inches across the western Hill Country and over areas to the west and southwest of Austin. Isolated totals up to 5 inches were recorded in the Hill Country. Rainfall during this period caused soils to saturate and led to minor rises on area creeks and streams.

Flooding began on Nov. 17, as a strong wave of low pressure, moving northeast from Mexico, caused very heavy rains across the entire region. Across the Hill Country and much of Central Texas, widespread rain amounts of 3 to 5 inches caused considerable runoff. Extensive flooding occurred Nov. 17 along the Pedernales, Llano, San Saba and Pecan Bayou watersheds. A peak flow of 84,300 cubic feet per second (cfs) was measured at the Llano River at Llano gauge. The Pedernales River at Johnson City peaked at 29,100 cfs, and Sandy Creek near Kingsland peaked at 12,000 cfs. Also on Nov. 17, the Colorado River near San

Nov. 14 - 19: Highland Lakes Basin (continued)

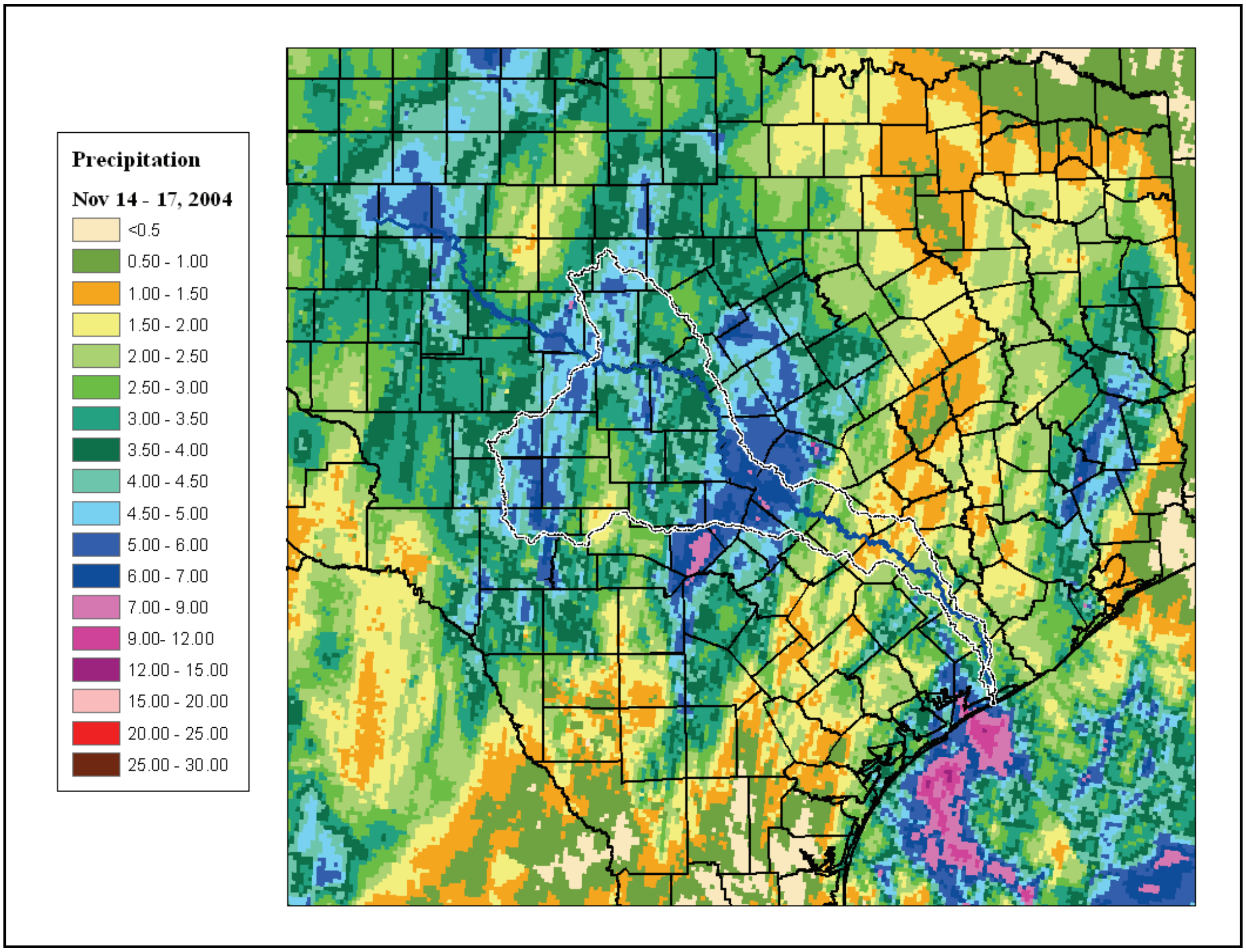

Figure 2 — Rainfall Nov. 14 - 17

Saba climbed to more than 20,000 cfs and continued rising into the following day (See Table 2 and Figure 7).

Floodgate operations commenced on Nov. 17 with the opening of four floodgates at Wirtz Dam (which forms Lake LBJ), all 10 floodgates at Starcke Dam (which forms Lake Marble Falls), and three floodgates at Buchanan Dam (which forms Lake Buchanan). At Inks Dam (which forms Inks Lake and has no floodgates), water rose to 3.92 feet above its overflow spillway (See Table 3).

Below the Highland Lakes, widespread rainfall totals of 1 to 3 inches from Austin to the coast saturated the soils and generated minor runoff at most locations but caused a localized rise on the Colorado River at Austin.

On Nov. 17, Mansfield Dam and Lake Travis protected the lower river by absorbing an estimated peak inflow of 141,000 cfs. Floodgate operations at Mansfield Dam were initially constrained by U.S. Army Corps of Engineers regulations for flood control operations at Mansfield Dam because of the rise on the Colorado River at Austin. The regulations limit flood releases from Mansfield Dam when Lake Travis is forecast to remain below 710 feet msl so that the Colorado River below the Highland Lakes does not exceed stages of 20.5 feet at Austin, 25.1 feet at Bastrop, or 35.5 feet at Columbus. Based on the forecasted elevation of Lake Travis, two floodgates were initially opened at Mansfield Dam (which forms Lake Travis), and two floodgates were opened at Tom Miller Dam (which forms Lake Austin). With high inflows to the lake and the Colorado River at Austin near its control limit, Lake Travis climbed sharply about 10 feet from elevation 680.74 to 690.10 feet msl (See Figure 12).

Nov. 14 - 19: Highland Lakes Basin (continued)

Overnight on Nov. 17 and into the early morning hours of Nov. 18, runoff to the Colorado River at Austin from areas below Mansfield Dam began to decline faster than anticipated, and the river stage at Austin quickly fell below its control limit. Consequently, two additional floodgates were opened at Mansfield Dam with the objective of maintaining the stage at Austin at or below 20.5 feet in accordance with the Corps of Engineers regulations, so that a total of four floodgates were opened in addition to hydroelectric generation releases. Discharge from Mansfield increased to a maximum of about 28,700 cfs.

Rainfall was light on Nov. 18 and 19, but flood operations continued as large volumes of runoff from the further reaches of the upper basin flowed to Lake Buchanan. On Nov. 18, the San Saba River near San Saba peaked at 22,700 cfs, and the Colorado River near San Saba peaked at 32,900 cfs. Pecan Bayou at Mullin peaked the following day at 11,400 cfs. Inflows to Lake Buchanan peaked at about 31,500 cfs on Nov. 19. A nearly steady discharge from Buchanan Dam of about 24,000 cfs was passed through the Highland Lakes chain to Lake Travis through Nov. 19. Inflows and outflows on Lake Travis remained roughly balanced, and the level of Lake Travis began to plateau by Nov. 20 at an elevation of 693.3 feet msl.

Nov. 20 - 21: Coastal Plains

A second period of very heavy rain developed Nov. 20 and 21 as small but very intense thunderstorms developed along the coastal plains between Wharton and Victoria. These extremely heavy storms developed along a warm front and remained nearly stationary

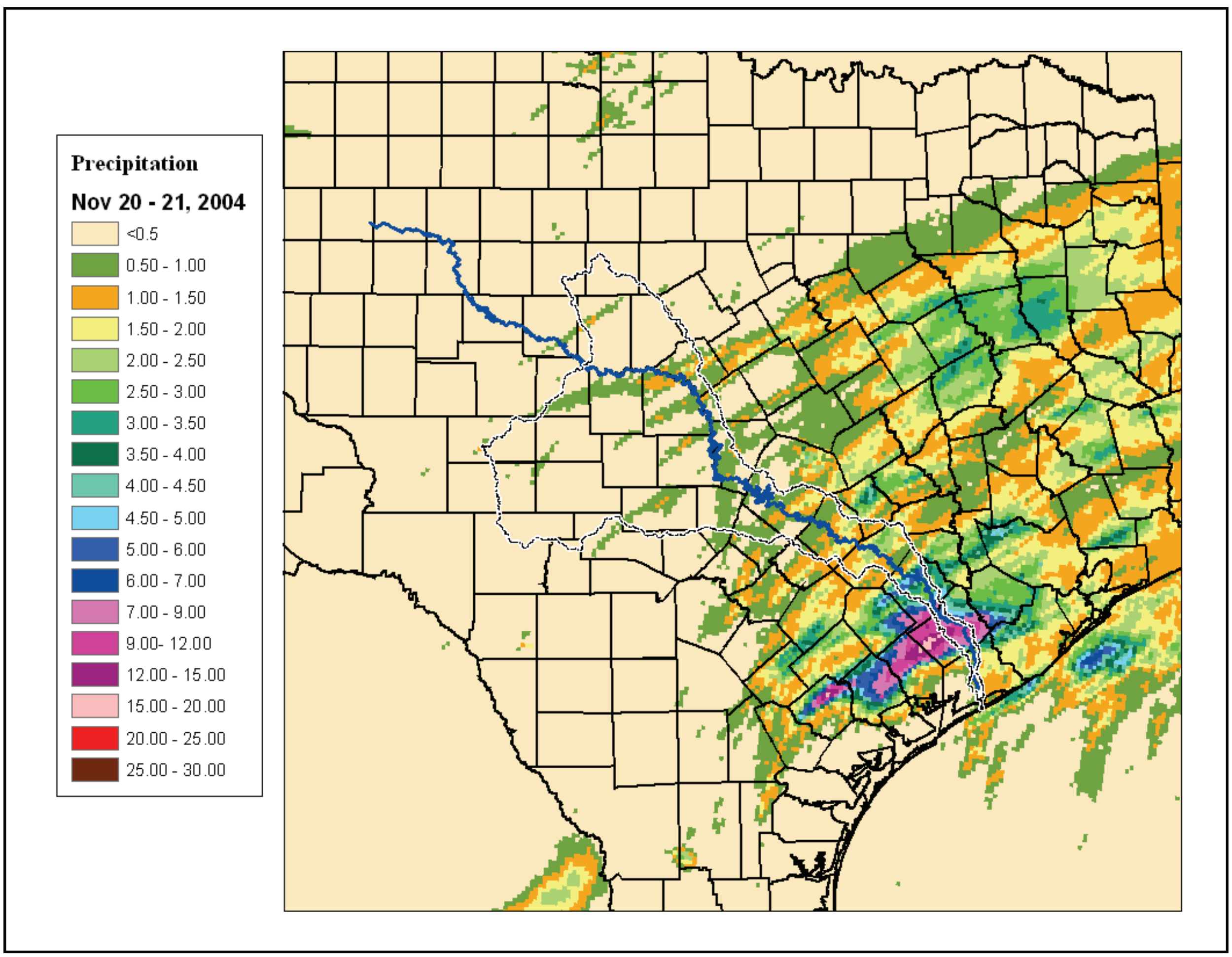

Figure 3 — Rainfall Nov. 20 – 21

Nov. 20 - 21: Coastal Plains (continued)

for more than 12 hours and covered parts of Wharton, Jackson and Matagorda counties. Rainfall totals of 12 to 17 inches were recorded in the area along U.S. Highway 59 between El Campo and Ganado.

The Colorado River watershed narrows through the coastal counties, so that much of this rain fell over areas draining away from the Colorado River. The extremely intense rainfall caused extensive, localized flooding to homes and businesses, particularly in the El Campo area. However, the stage of the Colorado River at Bastrop and Columbus did not exceed their respective control limits set by the Corps of Engineers regulations, and the Colorado River remained below flood stage at all locations below the Highland Lakes.

Flood operations on the Highland Lakes continued with no major changes. On Nov. 20, rainfall in the Austin area caused the stage of the Colorado River at Austin to briefly exceed its control limit of 20.5 feet. Discharge from Mansfield Dam was briefly reduced, and the stage at Austin was controlled. Discharge from Buchanan Dam continued to pass through the Highland Lakes to Lake Travis at a rate of about 23,000 cfs as a result of decreased inflows to Lake Buchanan. Releases from Buchanan Dam began to be reduced slightly by Nov. 21. The discharge from Lake Travis of about 25,500 cfs was still slightly less than inflows to prevent exceeding the Austin stage limitation, and Lake Travis rose to about 694.5 feet msl by Nov. 22.

Nov. 22 - 23: Colorado River Basin from Austin to Columbus

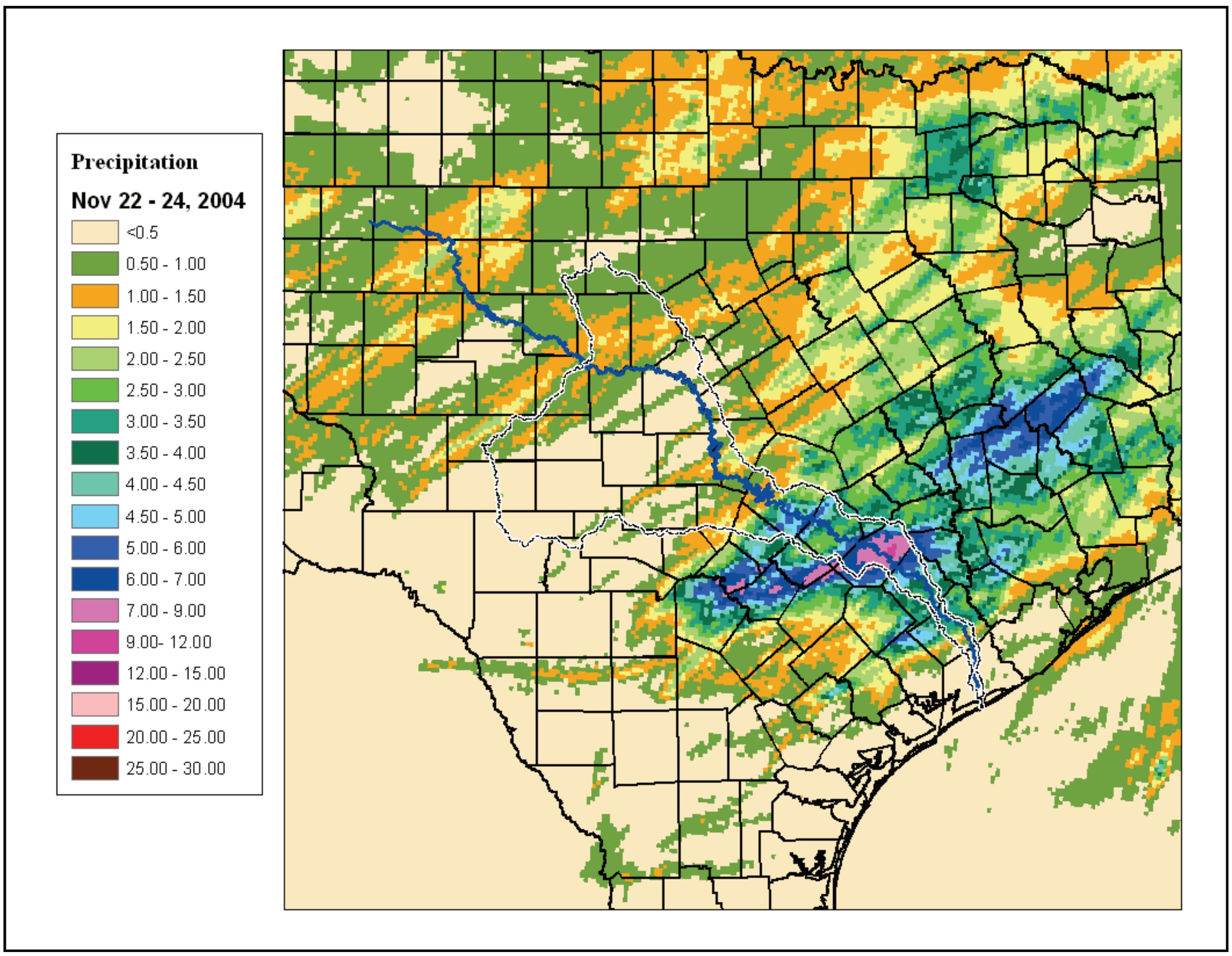

Figure 4 — Rainfall Nov. 22 - 23

A third period of very heavy rain began on Nov. 22, when the warm front along the coast moved north and another strong wave of low pressure moved northeast from Mexico. The wave moved along a path that caused the development of very heavy rain and strong storms downriver of the Highland Lakes from the Austin area to Wharton County. Rainfall of 4 to 6 inches occurred in the Austin area during the early morning hours of Nov. 22, causing considerable flooding of creeks, streams and roads.

Nov. 22 - 23: Colorado River Basin from Austin to Columbus

Very heavy rains developed later that morning and into the afternoon from south of Austin to just north of the coast. Fayette and Colorado counties were especially hard hit as storms training over an area from east of San Antonio to Gonzales to La Grange produced widespread totals of 7 to 12 inches. Rain totals of 12 to 15 inches were recorded over parts of Fayette and Colorado counties. These tremendous rain amounts caused the widespread flooding of creeks and streams from Austin to south of Columbus. Runoff across this area caused a significant rise in the level of the Colorado River from Austin to the coast.

The stage of the Colorado River at Austin began to rise during the early morning of Nov. 22 in response to the heavy rainfall in the Austin area. As the river flows began to exceed the downstream control stages, the discharge from Mansfield Dam was reduced in increments from 1 to 8 a.m., when all but one floodgate at Mansfield Dam was closed. As the heavy rains continued south of Austin later that day, Cummins Creek near Frelsburg peaked at 26,500 cfs. In accordance with the Corps of Engineers regulations, when forecasts indicated that control stages at Bastrop and Columbus would be exceeded, the final floodgate was closed and all discharge from Mansfield Dam was stopped at 1:47 p.m. on Nov. 22 (See Figure 10).

Lake Travis immediately began a slow but steady secondary rise as inflows to the lake exceeded the discharge from Mansfield Dam. The slight reduction in releases from Buchanan Dam that began on Nov. 21 were further reduced as possible on Nov. 22, thus slowing the rise on Lake Travis (See Figure 11).

The following day, Nov. 23, local runoff from areas below Mansfield Dam, especially from the 12- to 15-inch rains over Fayette County, caused increasingly higher flows at locations further downriver from Austin to LaGrange. At Austin, the Colorado River peaked in moderate flood stage at 37,700 cfs. At Bastrop, the river peaked in major flood stage at 54,300 cfs. At Smithville, the river peaked in major flood stage at 64,300 cfs. At LaGrange, the river peaked in major flood stage at 77,500 cfs (See Table 2 and Figure 8).

Additional rain developed Nov. 23 when another wave of low pressure caused the development of strong to severe storms across parts of the region. The storms produced large hail, strong winds and isolated tornadoes. Fortunately, the storms only produced modest rain amounts of 0.5 to 0.75 inch. The arrival of cooler and drier air on Nov. 24 finally brought an end to this period of unseasonably heavy rain.

After careful consideration of the lag time for flood flows to travel from Mansfield Dam to Wharton and Bay City – and with approval from the Corps of Engineers' Reservoir Control Center - releases from Mansfield were resumed on Nov. 24. This time frame allowed the flood waters to fully recede at Wharton and Bay City before releases from Mansfield Dam reached those locations (See figures 8 and 10).

At Wharton, the Colorado River peaked in major flood stage at 72,900 cfs on Nov. 24 – slightly attenuated from its peak upstream at Columbus. Below Wharton, the river was still swollen from the intense rains of Nov. 20 and 21. When the flood wave from upstream arrived at Bay City on Nov. 27, the river peaked above action or bank-full stage at 86,900 cfs (See Figure 8).

Lake Travis reached its maximum level of 696.7 feet msl late on Nov. 24. Lake Buchanan was allowed to rise to 1,019.9 feet msl by Nov. 28.

Flood Control Operations

Flood control operations at the dams forming the Highland Lakes are intended to reduce flood damages on the lakes and along the Colorado River below the Highland Lakes. This is accomplished by managing releases from the dams according to forecasted lake levels and river stages along the lower river. Lake and river forecasts are based on actual observed rainfall.

The six dams that form the Highland Lakes are operated as a system that is made up of three tandem pairs. Inks Dam (which forms Inks Lake) is operated in tandem with Buchanan Dam (which forms Lake Buchanan). Starcke Dam (which forms Lake Marble Falls) is operated in tandem with Wirtz Dam (which forms Lake LBJ), and Tom Miller Dam (which forms Lake Austin) is operated in tandem with Mansfield Dam (which forms Lake Travis). Lake Travis is the only reservoir in the system with storage capacity designated specifically for flood control.

Flood control operations at Buchanan, Inks, Wirtz, and Starcke dams are managed in accordance with an agreement reached in 1990

Flood Control Operations (continued)

Figure 5 — Mansfield Dam

between LCRA and the Federal Emergency Management Agency. Flood control operations at Mansfield Dam are managed in accordance with U.S. Army Corps of Engineers regulations for flood control operations at Mansfield Dam.

During the November 2004 flood, flood control operations on the Highland Lakes required interagency cooperation to monitor hydrologic conditions, forecast river and lake levels, and control releases from the dams. LCRA, in coordination with the U.S. Geological Survey, monitored hydrologic conditions reported by the LCRA Hydromet System of 220 rain gauges and 70 stream gauges. Data from the Hydromet System was provided in near real-time to LCRA and its partner agencies. The National Weather Service (NWS) staff at its River Forecast Center provided river stage and streamflow forecasts for the tributaries and main stem of the Colorado River draining to the Highland Lakes. Based on these forecasted inflows, LCRA staff at its River Operations Center prepared forecasts of lake elevations, and planned flood control operations in accordance with the applicable regulations and agreements. Operations at Mansfield Dam were coordinated with the Corps of Engineers' Reservoir Control Center. LCRA's forecasts of lake levels and discharges were shared with the NWS to ensure that the most up-to-date information was included in NWS forecasts of river levels downstream of the Highland Lakes.

Four floodgates were opened and closed at Mansfield Dam from Nov. 17 through Dec. 3. Lake Travis was at elevation 678.6 feet msl at the beginning of the event. The estimated inflow to Lake Travis peaked at 141,000 cfs on Nov. 17, while the maximum discharge from Mansfield Dam was only 28,700 cfs on Nov. 18. Lake Travis reached its maximum level of 696.7 feet msl on Nov. 24 at 8:45 p.m., more than 15 feet into the flood pool, with four floodgates open. After Dec. 3, Lake Travis was gradually brought back to 681 feet msl by Jan. 13, 2005. The estimated inflow volume to Lake Travis between Nov. 14 and Jan. 13 was 876,000 acre-feet with an estimated outflow volume of 832,000 acre-feet, for a net increase in storage of 44,000 acre-feet. Lake Buchanan also gained an estimated 32,000 acre-feet in storage, for a system storage increase of 76,000 acre-feet. After Jan. 13, continuing inflows to Lake Travis required flood control releases from Lake Travis by hydroelectric generation to continue through Feb. 17, 2005, when the final floodgate was closed at Tom Miller Dam.

Through successful operation of the Highland Lakes, the estimated peak flow at Mansfield Dam above Austin was reduced about 112,300 cfs, from 141,000 cfs to 28,700 cfs. Lake Travis greatly reduced the significant flooding along the lower river that occurred following heavy rainfall below the Highland Lakes on Nov. 20 and 21. The Highland Lakes retained about 76,000 acre-feet of the flood within the storage pool designated for water supply.

Summary

A series of storms moved across Texas during November 2004, resulting in one of the wettest Novembers in the state since weather records began in 1895. Across the Colorado River basin, heavy rains fell in three distinct periods of very heavy rain, severe storms and flooding that affected different portions of the Colorado River basin. The changing patterns of heavy rainfall and flood runoff required LCRA to constantly evaluate conditions and adjust flood control operations on the Highland Lakes.

Flood control operations on the Highland Lakes required interagency cooperation – by the U.S. Geological Survey, National Weather Service, U.S. Army Corps of Engineers, LCRA and others – to monitor hydrologic conditions, forecast river and lake levels, and control releases from the dams.

Successful operation of the Highland Lakes greatly reduced flood damages on the Highland Lakes and the Colorado River and retained a portion of the flood for water supply. Although heavy rainfall below the Highland Lakes on Nov. 20 and 21 caused significant flooding along the lower river, the estimated peak discharge from Mansfield Dam was reduced by about 112,000 cubic feet per second (cfs), from 141,000 to 28,700 cfs. The Highland Lakes retained about 76,000 acre-feet of the flood within the water supply pool.

Rainfall Statistics

Rainfall statistics for November 2004 include:

- Of 178 gauges, 79 recorded more than 7.0 inches.
- All 178 gauges reporting basinwide recorded an average of 6.72 inches.
- 137 gauges around and above the Highland Lakes averaged 5.86 inches.
- 41 gauges around Austin and downstream to Bay City averaged 9.61 inches.
- 23 gauges recorded 10 inches or more (See Table 1).

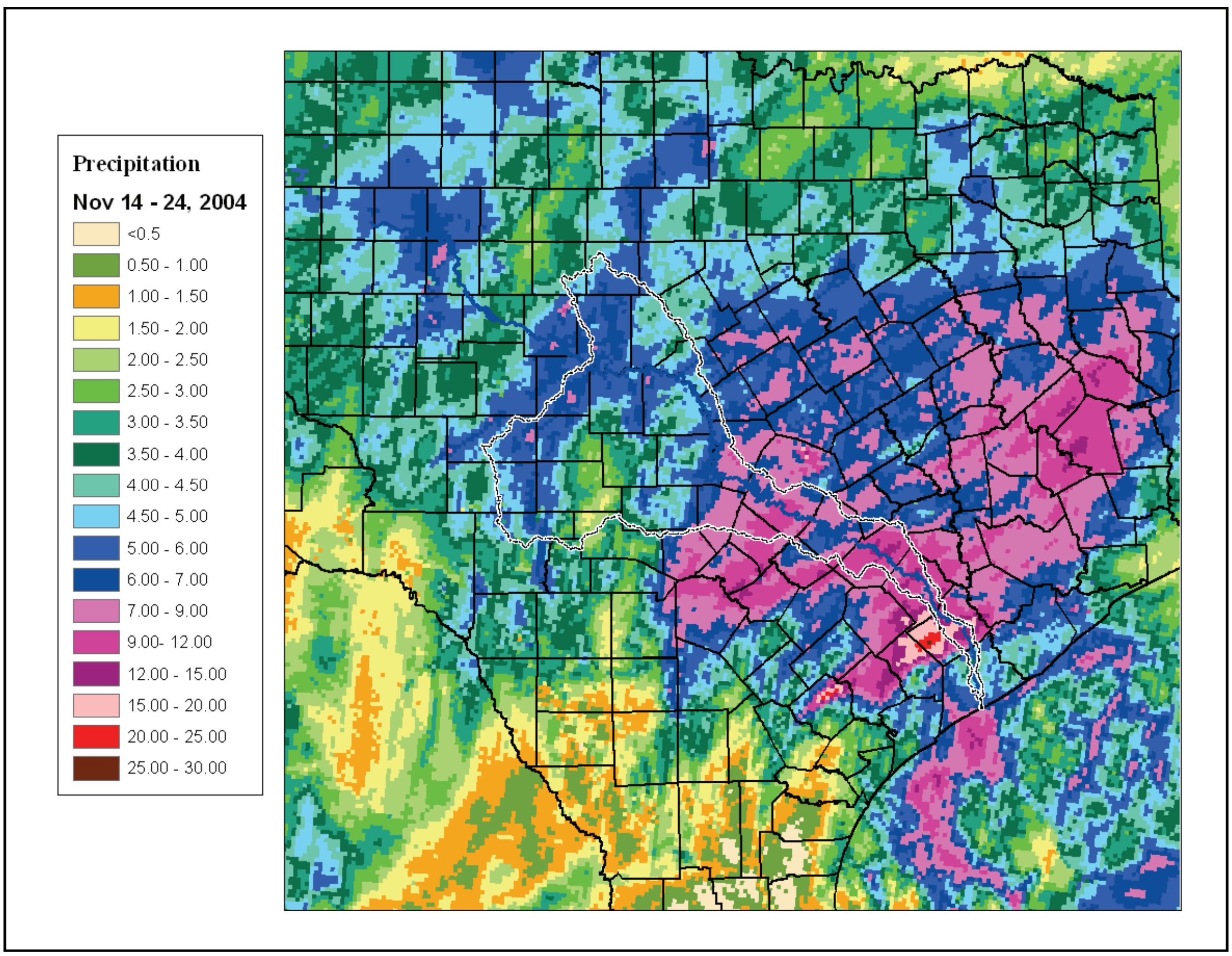

Figure 6 — Rainfall Nov. 14 - 24

Rainfall Statistics (continued)

Table 1 — Rain Gauges Recording Greater Than 10 Inches

Nov. 14 - 24, 2007

Rainfall (inches)	Rain Gauge Name
18.29	El Campo 15 WSW
17.37	Colorado River at Wharton
14.24	Colorado River at Columbus
12.96	Colorado River above La Grange
12.53	Weimar 7 S
12.34	Colorado River near Lane City
12.27	Town Lake near Longhorn Dam
11.94	Buckners Creek near Muldoon
11.64	Manchaca 4 W
11.58	Colorado River near Glen Flora
11.49	La Grange 5 NE
10.94	Bellville 1 SW
10.93	Barton Creek at Loop 360, Austin
10.88	Blanco 5 NNE
10.72	Lake Austin at Davenport Ranch
10.59	Hallettsville 1 SSE
10.57	Marble Falls 6 ENE
10.41	San Bernard River at East Bernard
10.38	Burnet 6 SSE
10.10	Cummins Creek near Frelsburg
10.05	Eagle Lake 7 NE
10.03	Johnson City 5 SSW
10.00	Muldoon 6 WSW

River Conditions

The Colorado River and all its major tributaries were at low flows before the rainfall started.

Table 2 — River Stages

Gauge Location	Action Stage in Feet	Flood Stage in Feet	Moderate Flood Stage in Feet	Major Flood Stage in Feet	Maximum Stage Nov. 2004 in Feet	Maximum Flow Nov. 2004 in cfs	Date of Maximum Stage and Flow
Colorado River at Winchell	24	26	30	34	**20.62**	13,600	11/17/2004
Pecan Bayou at Mullin	20	40	45	48	**24.37**	11,400	11/19/2004
San Saba River at Menard	12	18	22	26	**16.14**	25,400	11/17/2004
San Saba River near Brady	16	30	33	38	**16.31**	29,300	11/17/2004
San Saba River at San Saba	20	24	27	31	**27.89**	22,700	11/18/2004
Colorado River near San Saba	25	30	34	38	**25.22**	32,900	11/18/2004
Llano River near Junction	12	16	22	31	**31.36**	116,000	11/17/2004
Llano River near Mason	6	13	19	23	**21.31**	85,900	11/17/2004
Llano River at Llano	10	10	12	23	**22.04**	84,300	11/17/2004
Sandy Creek near Kingsland	8	12	14	20	**11.8**	12,200	11/17/2004
Pedernales River near Fredericksburg	12	22	25	32	**8.99**	2620	11/17/2004
Pedernales River near Johnson City	13	14	17	19	**17.59**	29,100	11/17/2004
Colorado River at Austin	16	24	29	33	**25.87**	37,700	11/22/2004
Colorado River at Bastrop	14	23	25	28	**31.62**	54,300	11/23/2004
Colorado River at Smithville	10	20	23	28	**27.82**	64,300	11/23/2004
Colorado River above La Grange	19	26	32	37	**41.53**	77,500	11/23/2004
Cummins Creek near Frelsburg	N/A	N/A	N/A	N/A	**36.38**	26,500	11/22/2004
Colorado River at Columbus	30	34	39	43	**42.87**	76,400	11/24/2004
Colorado River at Wharton	20	39	41	43	**48.26**	72,900	11/26/2004
Colorado River at Bay City	23	44	45	46	**42.2**	86,900	11/27/2004

River Conditions (continued)

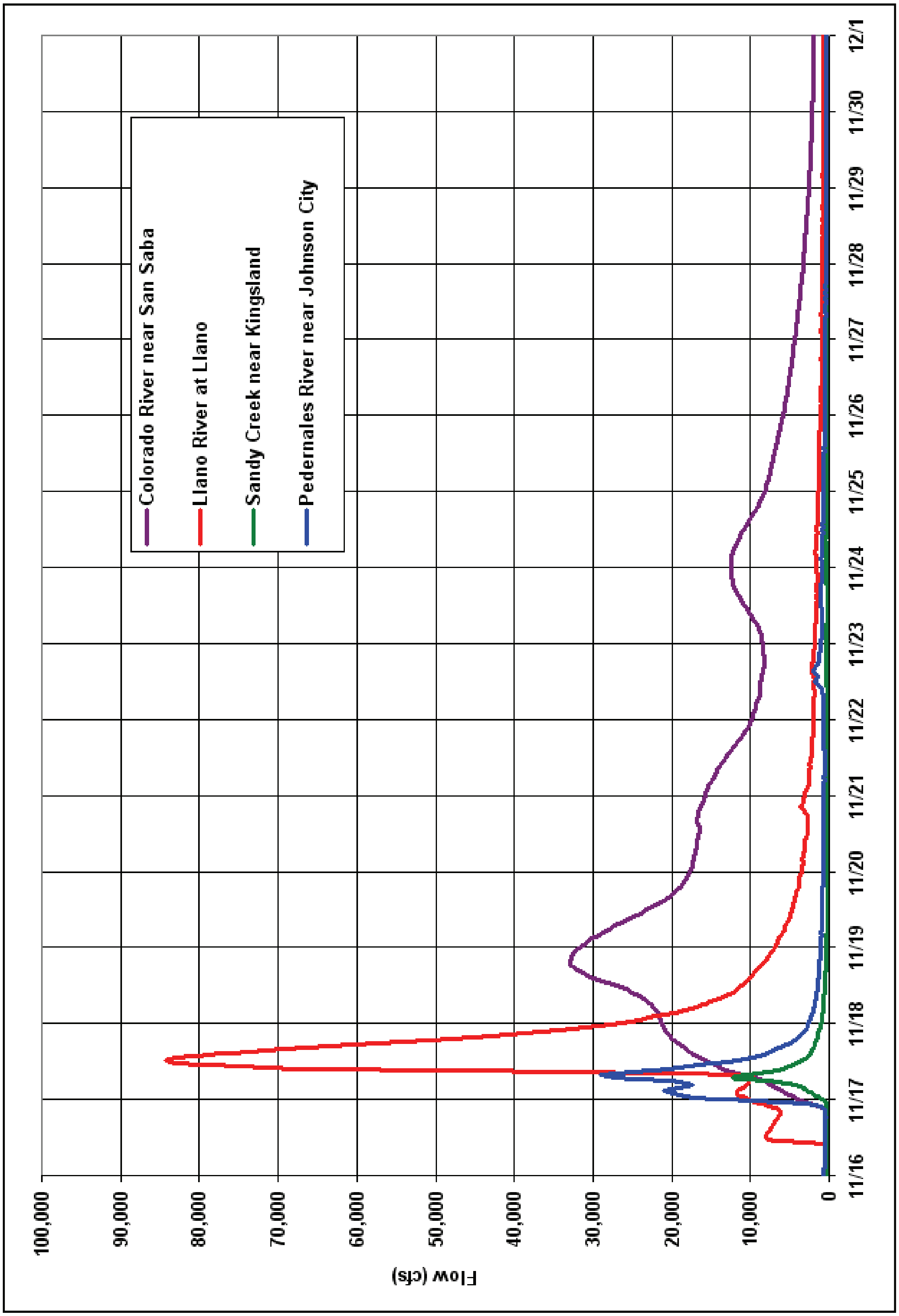

Figure 7 — Streamflow Above the Highland Lakes Nov. 15 - 30

River Conditions (continued)

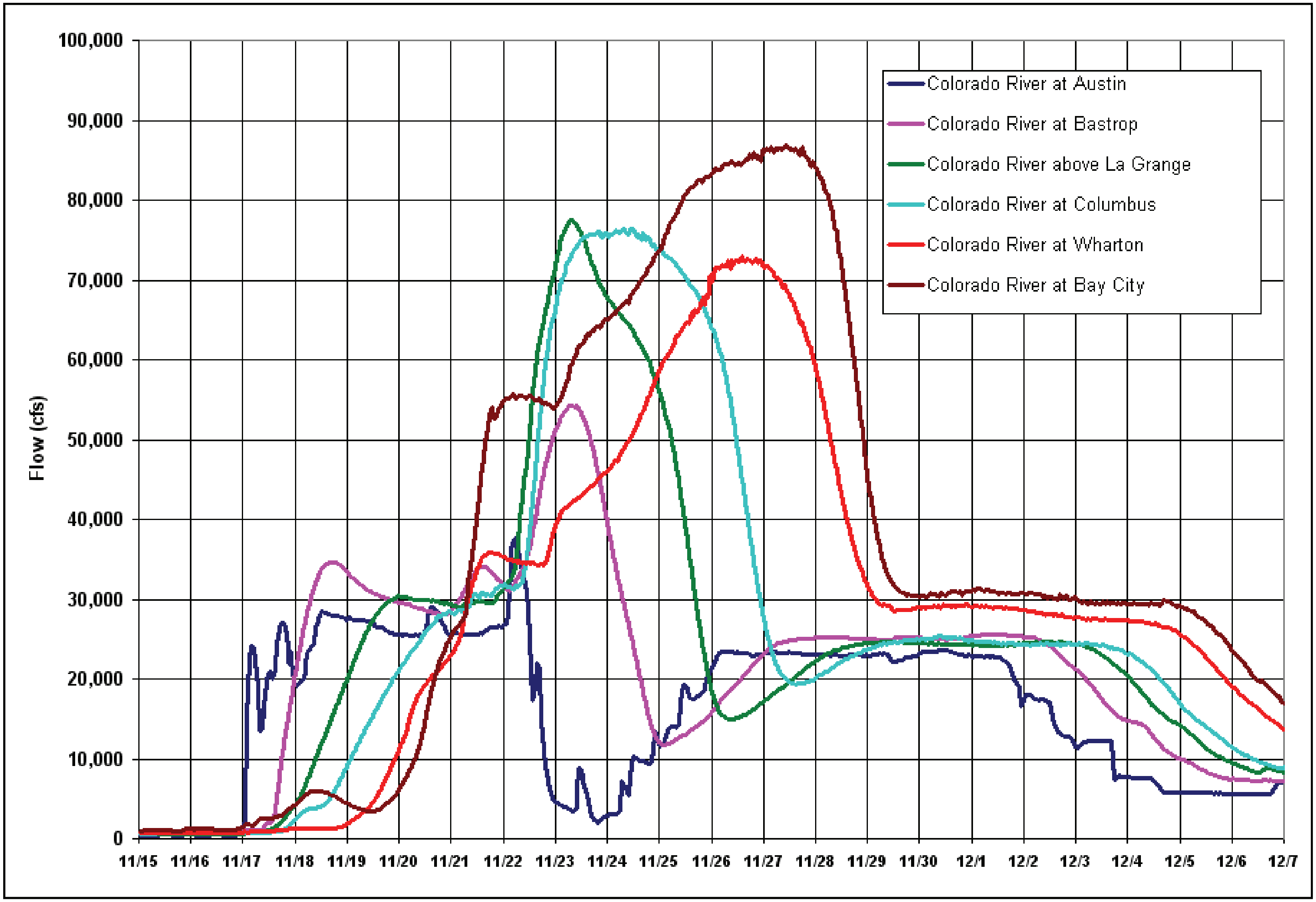

Figure 8 — Streamflow Below the Highland Lakes Nov. 15 - Dec. 7

River Conditions (continued)

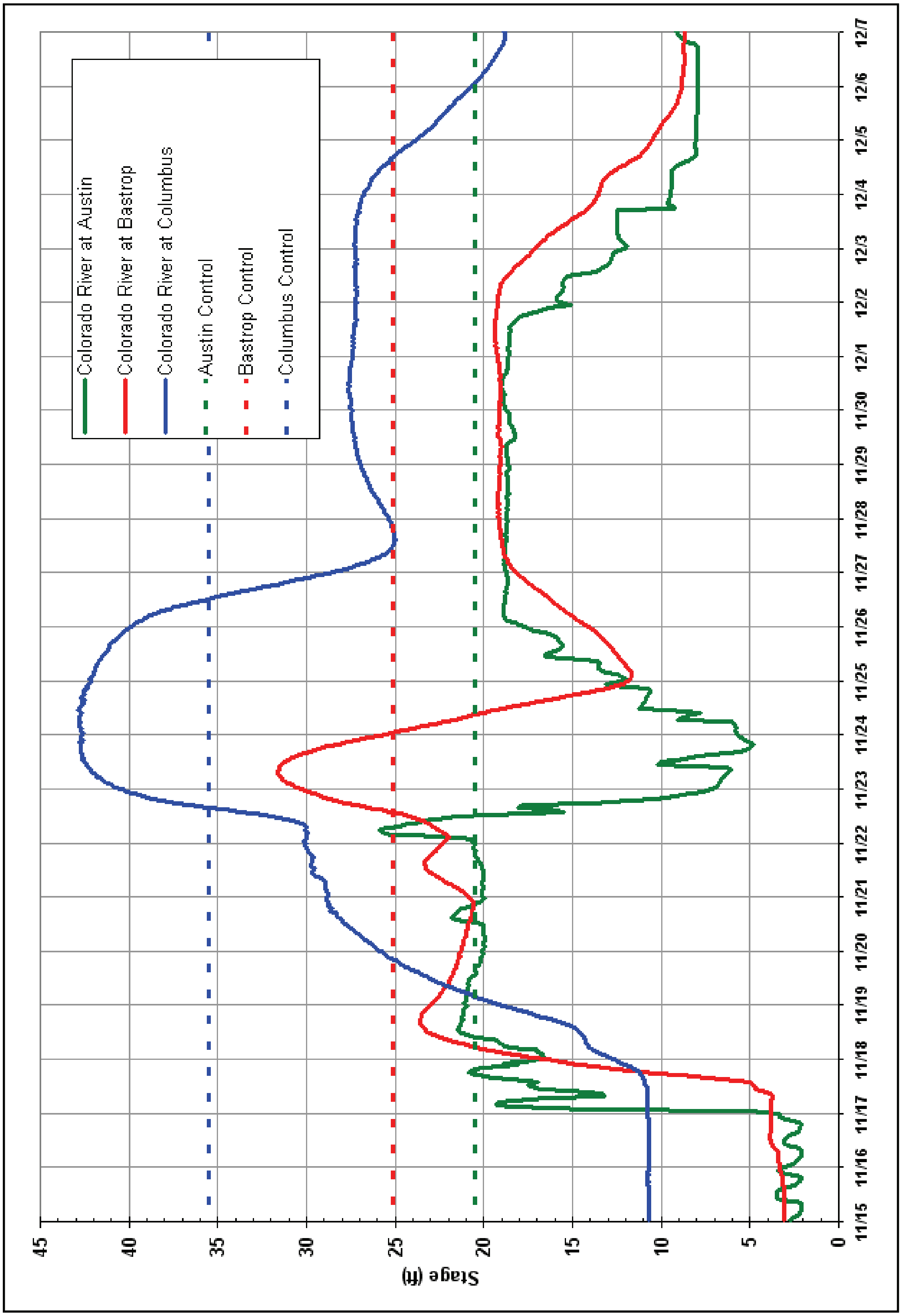

Figure 9—Control Point Stages

River Conditions (continued)

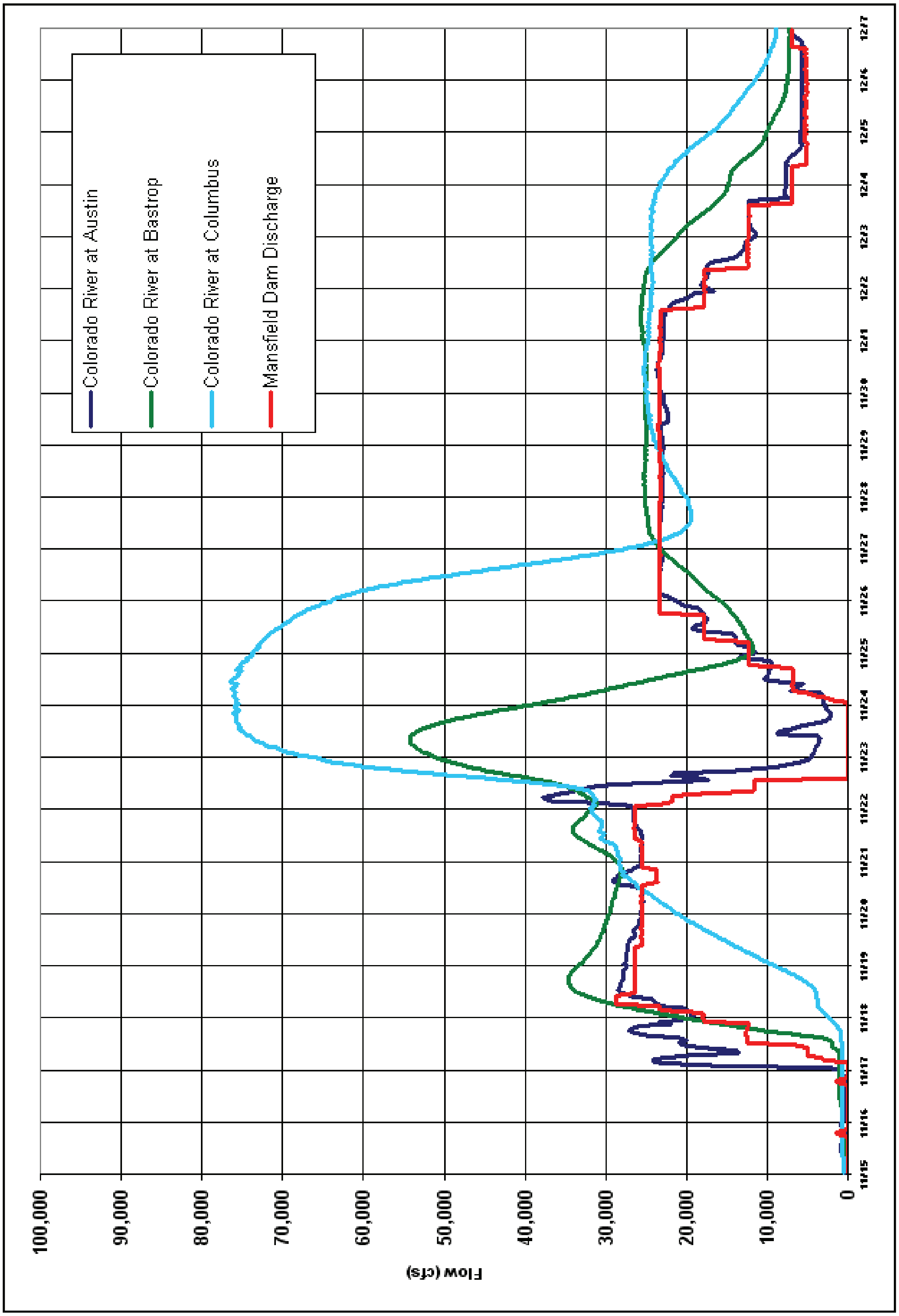

Figure 10 — Control Point Gauge Flows and Mansfield Dam Discharge

Operations

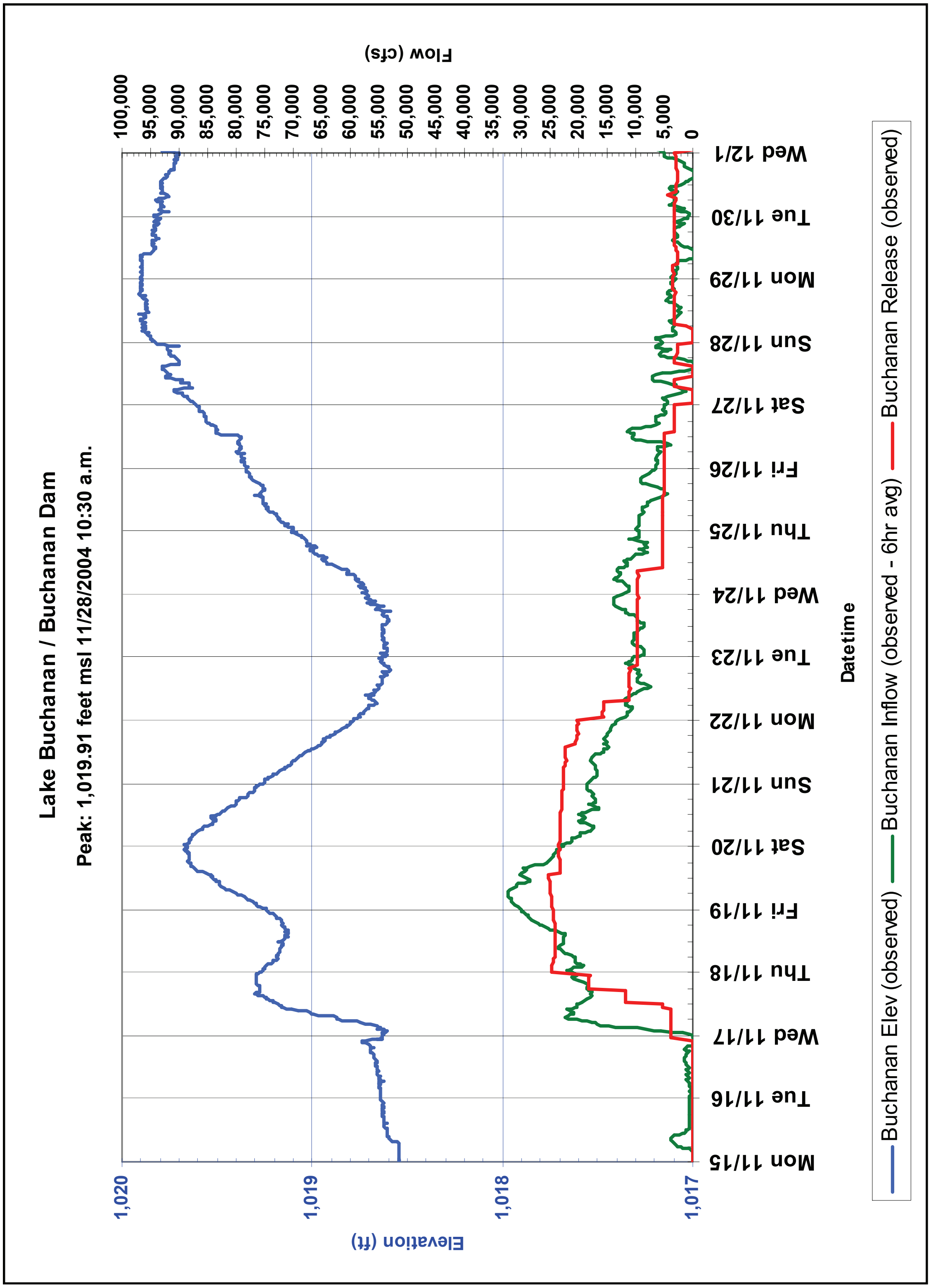

Figure 11 — Lake Buchanan and Buchanan Dam Elevation, Inflow and Release

Operations (continued)

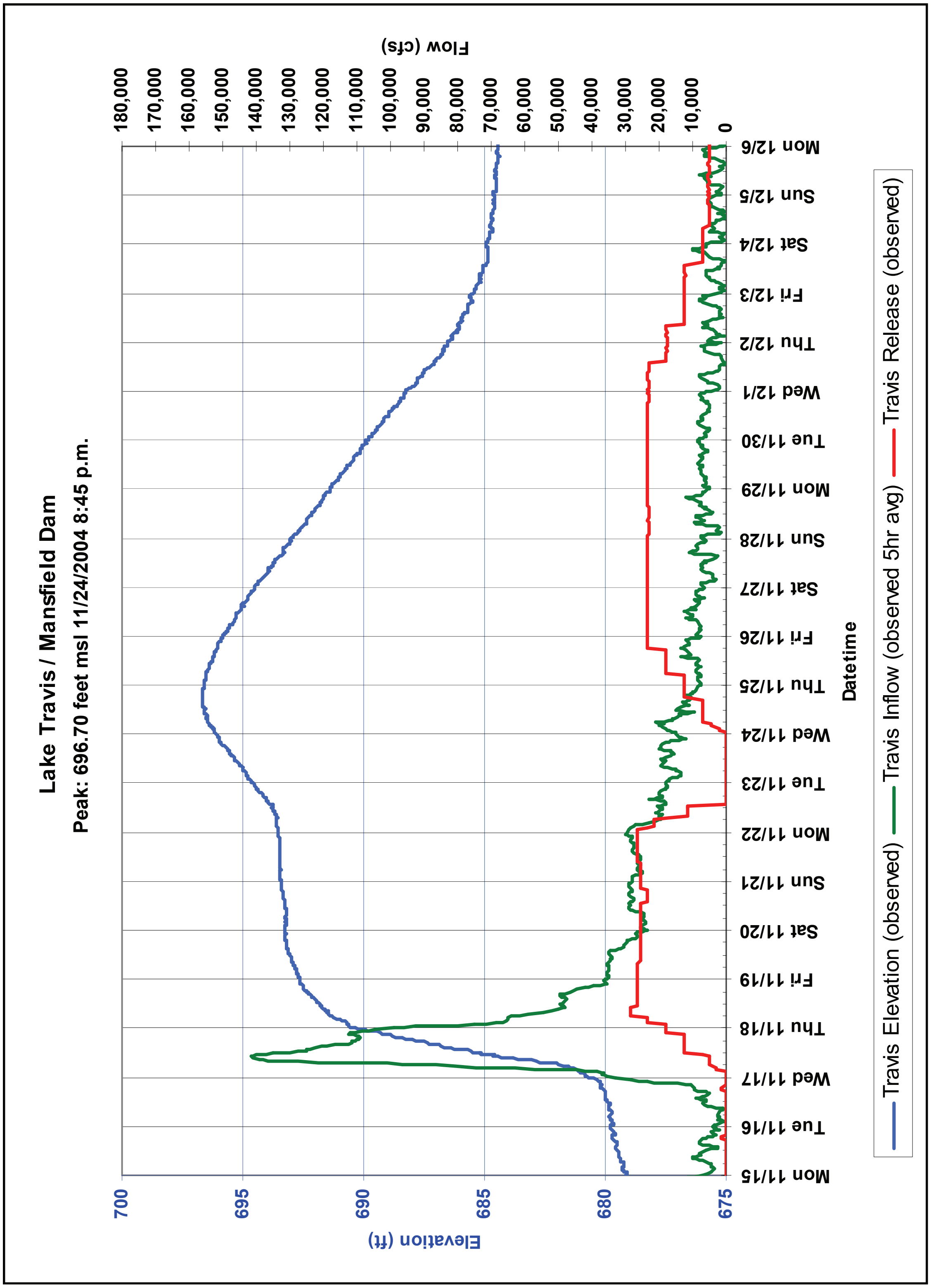

Figure 12 — Lake Travis and Mansfield Dam Elevation, Inflow and Release

Operations (continued)

Table 3 summarizes the operating ranges, maximum elevations, number of gates and maximum discharge for each of the six Highland Lakes Dams.

Table 3 — Highland Lakes and Dams

Lake	Operating Range	Maximum Level Nov. 2004	Maximum Number of Open Gates	Estimated Peak Inflow (cfs)	Peak Discharge (cfs)
Lake Buchanan	1020.0	1019.9	3	31,500	25,200
Inks Lake	886.9 - 887.7	892.3	---	29,400	29,400
Lake LBJ	824.4 - 825	825.3	4	100,000	97,300
Lake Marble Falls	736.2 - 737.0	737.8	10	98,000	93,500
Lake Travis	681.0 - 750.0	696.7	4	141,000	28,700
Lake Austin	491.8 - 492.8	492.1	6	30,000	30,000

Historical Comparison

Tables 6 - 9 present historical peak elevations for Lake Travis and peak stages for Colorado River at Bastrop, Colorado River at Columbus and Colorado River at Wharton. November 2004 values are highlighted in yellow.

Table 4— Historical Lake Travis Peak Elevations

Rank	Elevation (ft msl)	Date	Volume (acre feet)
1	710.44	12/26/1991	1,172,000*
2	707.38	5/18/1957	2,700,000
3	705.11	6/25/1997	832,000
4	704.83	2/08/1992	1,172,000*
5	**696.70**	**11/24/2004**	**876,000**
6	693.50	7/07/2002	1,118,081
7	693.48	6/14/1987	N/A
8	692.58	10/7/1959	N/A
9	692.42	4/18/1977	N/A
10	692.09	1/30/1968	N/A
11	691.73	5/30/1968	N/A

Table 5 — Historical Colorado River Stages at Bastrop

Rank	Stage (ft)	Date
1	60.3	7/7/1869**
2	57.0	6/16/1935**
3	53.3	12/4/1913**
4	37.48	12/22/1991
5	34.45	10/29/1960
6	32.30	10/19/1998
7	**31.62**	**11/22/2004**
8	30.96	11/17/2001
9	30.7	6/14/1981
10	29.45	6/14/1987

* Two-peak event, volume is sum.

* * Prior to Mansfield Dam construction.

Historical Comparison (continued)

Table 6 — Historical Colorado River Stages at Columbus

Rank	Stage (ft)	Date
1	51.6	12/06/1913**
2	51.6	7/10/1869**
3	48.5	6/18/1935**
4	48.4	7/26/1938**
5	46.05	7/01/1940**
6	43.66	10/21/1998
7	**42.87**	**11/24/2004**
8	41.28	7/29/1938**
9	41.28	12/25/1991
10	37.57	10/18/1994

Table 7 — Historical Colorado River Stages at Wharton

Rank	Stage (ft)	Date
1	51.9	7/12/1869**
2	51.9	12/8/1913**
3	51.2	6/20/1935**
4	50.7	6/3/1929**
5	50.4	/ 30, 1938**
6	48.99	7/3/1940**
7	48.75	10/23/1998
8	48.6	5/6/1922
9	**48.25**	**11/26/2004**
10	48.2	11/26/1940**
11	46.07	12/27/1991

* * Prior to Mansfield Dam construction.

About LCRA

LCRA is a conservation and reclamation district created by the Texas Legislature in 1934. LCRA provides energy, water and community services to the people of Texas. It cannot levy taxes, but funds its operations with income from the sale of electricity, water and other services.

LCRA generates electricity and sells it wholesale to city-owned utilities and cooperatives that serve more than 1.1 million people in Texas. LCRA also builds and operates transmission projects through a nonprofit corporation, manages and protects the lower Colorado River, provides water and wastewater utilities, owns and operates parks, and offers economic and community development assistance to communities.

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